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(54) **Hydrogel bandages.**

(57) A hydrogel dressing is provided which is suitable for adherence to an adhesive coated backing of a bandage. The dressing consists of a layer of hydrogel in face-to-face relationship with a substrate. The hydrogel facing surface of the substrate preferably comprises fibers projecting into the hydrogel and the opposed surface preferably comprises a hydrogel occlusive polymeric film. The hydrogel is crosslinked, in situ, on the substrate and thereby firmly anchors thereto. The occlusive film assures adhesion of the dressing to an adhesive coated bandage backing.

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Field of the Invention

This invention relates to hydrogel bandages and methods for forming the same.

5 Background of the Invention

The use of hydrogels in the treatment and management of burns and wounds is well known in the art. Hydrogel dressings are further desirable because wound exudate does not generally dry and consolidate with hydrogels or hydrogel laminates. Consequently, removal of a hydrogel dressing is usually neither painful nor
10 detrimental to the healing process. It has been suggested that hydrogel dressings may be particularly desirable for treatment of burns because they may accelerate healing. Although the mechanism by which hydrogels stimulate healing is not fully elucidated, it is documented that the high water content of hydrogels enables them to effect an immediate cooling of the wound surface and to sustain the reduced temperature for up to six hours. Davis, et al., "A New Hydrogel Dressing Accelerates Second-Degree Burn Wound Healing," Poster Presentation, *Wound Healing Society First Annual Meeting*, Galveston, Tx, Feb. 6, 1991. In addition, water swollen hydrogels may provide a cushioning effect that helps protect the burn or wound from physical trauma.

U.S. Patent 4,438,258 relates to hydrogels which may be used as interfaces between damaged skin tissue and its external environment. As disclosed therein, hydrogels may be polymerized about some type of support, such as a mesh of nylon, used as an unsupported film, spun in fibers and woven into a fabric, or used as a
20 powder. Further, hydrogels may be used to provide a controlled release of medical composition.

U.S. Patent 4,552,138 discloses a wound dressing material of at least one layer of polymeric, hydrophilic gel wherein the gel is cross-linked and acetalized with formaldehyde. As disclosed therein, a gel film may be formed by spreading a pre-crosslinked gel on an auxiliary carrier, drying and at the same time cross-linking the same by heat treatment. As used in this disclosure, uncrosslinked polyvinyl alcohol is dissolved in water,
25 acidified, preferably by hydrochloric acid, and combined with an aqueous formaldehyde solution and left to react or pre-crosslink at 50-80°C for several hours to obtain a gelatinous mass wherein no further free aldehyde can be detected. Such gel films may be placed on the wound as such, but they are preferably processed to a laminated product with one or more carrier materials and used in this form. The carrier layers are laminated into or onto the pre-crosslinked gel layer and may be further crosslinked to bond more firmly with the gel.

U.S. Patent 4,554,317 discloses a synthetic hydrophilic membrane prepared by graft polymerization of hydrophilic monomers with a polyurethane substrate. This membrane is particularly useful as a wound covering material. In one embodiment of this invention, the graft polymerization is initiated by X-ray or gamma radiation or an initiator such as a cerium salt.

EPO Publication No. 0 107 376 A1 discloses a tacky, non-rigid transparent and absorbent dressing comprising a layer of cross-linked polyvinylpyrrolidone gel containing from about 75-85% water. The dressing may
35 be prepared by dissolving between 15% and 25% by weight of polyvinylpyrrolidone in water and cross-linking the polyvinylpyrrolidone by means of ionizing radiation.

U.S. Patent 4,567,006 discloses a moisture vapor permeable, adhesive surgical dressing comprising a continuous film of a hydrophilic polymer. Such a dressing is suitable for use on moist wounds because it allows
40 water to evaporate rapidly from the wound area in the presence of an excess of exudate but, as the amount of exudate diminishes, so does the rate of evaporation. The resulting amount of exudate is enough to keep the wound moist without causing blistering of the dressing.

U.S. Patent 4,798,201 discloses a surgical dressing consisting essentially of a film which carries an adhesive layer for securing the dressing to the body. This dressing is also suitable for use on exuding wounds.

U.S. Patent 4,407,846 discloses a method of producing a hydrophilic membrane from a polyethylene base film by first irradiating the film of thickness not more than 150 μm with ionizing radiation in air or an oxygen
45 atmosphere. Then, without additional radiation, acrylic acid and/or methacrylic acid present in the form of an aqueous solution is grafted onto the irradiated film.

U.S. Patent 3,669,103 discloses a flexible support adapted to be caused to conform to a surface of a body, wherein the support confines a dry, solid, water-swellaable, water-insoluble polymeric sorbent to absorb aqueous fluid elaborated by the body to which the support is applied. The polymer sorbent is a lightly cross-linked polymer.

U.S. Patent 4,192,727 discloses a polyelectrolyte hydrogel and method for preparing the same. The polyelectrolyte hydrogel is formed by exposing an acrylate salt and acrylamide to a controlled intensity and dose
55 of ionizing radiation to effect simultaneous cross-linking and polymerization thereof. The resulting hydrogel is an insoluble hydrophilic copolymer which can contain or absorb aqueous fluid.

U.S. Patent 4,646,730 discloses a color stabilized sulfadiazine hydrogel dressing comprising a non-rigid layer of cross-linked polyvinylpyrrolidone gel having incorporated therein at least 0.1% by weight of silver sul-

fadiazine, which gel has been exposed to electron beam radiation and which gel also contains a color stabilizing amount of magnesium trisilicate.

U.S. Patent 4,750,482 discloses a wound or burn dressing comprising a web-like substrate coated with a layer of crosslinked, water-insoluble, hydrophilic elastomeric, pressure-sensitive adhesive gel of a gel-forming, water-soluble polymer derived from repeating units, predominantly of vinylpyrrolidone, polyethylene glycol wherein the cross-linked gel is formed by radiation cross-linking of a solution or dispersion of the polymer in the plasticizer and water. The gel retains the plasticizer within a cross-linked three-dimensional matrix of the polymer.

EPO Publication number 0 304 536 A2 discloses an occlusive wound dressing comprising an adhesive layer, a fabric layer bonded to the adhesive layer, a hydrophilic absorbent polymeric layer applied to the fabric layer, and at least one occlusive backing layer. The hydrophilic absorbent polymeric layer of this dressing is applied by pouring a monomer solution onto the fabric layer and thereafter curing to yield the polymeric layer.

Japanese Patent Application No. 57-7414 issued in the name of Saburo Otsuka and assigned to Nitto Electric Ind. KK, discloses a medicinal plaster formed by spraying or spreading a solution or dispersion containing a monomer, a medicine, a releasing aid for medicine, etc., on the surface of a tacky layer formed on a support, and then irradiating it with UV or ionizing radiation.

U.S. Patent 4,871,490 discloses a method of manufacturing hydrogel dressing from synthetic and natural polymers by radiation cross-linking. The method involves an aqueous solution comprising 2-10% by weight polyvinylpyrrolidone, no more than 3% by weight of agar and 1-3% by weight of polyethylene glycol. The solution is poured into a mould to shape the dressing. The mould is then tightly closed and subjected to an ionizing radiation dose in the range of 25-40 KGy.

At present, there are a few commercially available hydrogel dressings, for example, SECOND SKIN® from Speneo, VIGILON® from C.R. Bard and CLEARSITE® from New Dimensions in Medicine. Unfortunately, these have been structured in an unconventional way that fails to provide the convenience and familiarity that end users have grown accustomed to in using wound dressing such as adhesively attached finger bandages and patches.

One major reason for the difficulty in presenting a hydrogel dressing in a conventional format is the difficulty in handling the structurally weak gel and the incorporation of such a dressing into a high speed bandage producing process. Still another difficulty is that the gel is inherently incompatible with pressure sensitive adhesives i.e., the high water content of the gel precludes a gel dressing from securely adhering to a pressure sensitive surface. These problems have been addressed to a degree in a commonly assigned U.S. patent application U.S.S.N. 990,722 filed on December 15, 1992.* Described therein is a gel laminate capable of adhering to a pressure sensitive adhesive. The laminate comprising a substrate carrying a layer of polymeric adhesive. The gel is coated onto the polymeric adhesive and then the polymer of the gel is co-polymerized with the polymer of the adhesive; i.e., the gel and adhesive are united at the interface by covalent bonding. The gel laminate may then be affixed to a pressure sensitive adhesive coated bandage backing by adhering the substrate to the pressure sensitive adhesive.

While, in the main, the above-described system works well, to some degree the need for multiple layers makes production more complex and the need to select hydrogels and adhesives capable of co-polymerizing creates some constraints on the choice of materials. Accordingly, it is desirable to provide alternative methods and products for affixing a hydrogel dressing to an adhesive coated bandage backing.

Summary of the Invention

In accordance with this invention, a hydrogel dressing is provided which is suitable for adhering to an adhesive coated backing of a bandage and which is simple in construction and will allow for the use of essentially any crosslinkable hydrogel polymer.

Specifically, the dressing comprises a layer of hydrogel comprising a crosslinkable polymer and water. The hydrogel layer is in face-to-face relationship with a substrate, which substrate has a hydrogel facing surface and an opposed surface. The hydrogel facing surface comprises anchoring projections extending from the substrate and embedded into the hydrogel. The opposed surface is hydrogel occlusive and prevents any substantial amount of hydrogel from passing therethrough. In accordance with the teaching of this invention, the polymer of the hydrogel is crosslinked, in situ, on the hydrogel facing and thereby anchors the hydrogel to the surface by means of the anchoring projections.

In a specific embodiment of this invention the substrate comprises a laminate of a polymeric film as the

hydrogel occlusive surface and a fibrous fabric on the hydrogel facing surface. Projecting fibers from the fibrous fabric provide the anchoring projections. Since most fabric comprises a network of fibers or bundles of fiber e.g., yarns, they inherently exhibit an irregular surface pattern of raised portions and intersections. The raised portion may also serve in combination with projecting fibers or alone, as the anchoring projections. In fact, any feature extending from the surface of the substrate toward the gel may suffice to anchor the gel to the substrate after in situ crosslinking.

In a further embodiment of this invention the dressing is positioned upon a pressure sensitive adhesive coated bandage backing. The dressing is adhered to the backing by adhesion between the hydrogel occlusive surface of the dressing and the pressure sensitive coating.

Brief Description of the Drawings

Figure 1 is an enlarged, schematic cross-sectional view of a portion of a hydrogel dressing embodying the teachings of this invention;

Figure 2 illustrates, in perspective view an adhesively attachable bandage having positioned thereon the hydrogel dressing of Figure 1; and

Figure 3 is a cross-sectional view of the bandage of Figure 2, taken through line 1-1 thereof.

Detailed Description of the Invention

This invention relates to hydrogel dressings, useful in absorbent products such as bandages. Hydrogels are three-dimensional networks of hydrophilic polymers, generally covalently or ionically cross-linked, which interact with aqueous solutions by swelling to some equilibrium value. These cross-linked gels are generally formed from synthetic polymers such as polyvinylpyrrolidone; polyethyleneoxide; polyacrylate, polymethacrylate, and polyacrylamide polymers and copolymers, multivalent alcohols (such as polyvinylalcohol); biopolymers (such as gelatin, agar); or combinations thereof. For the purpose of preparing bandages or wound dressings, as in this invention, additional agents may be incorporated into the hydrogel, such as, but not limited to, color stabilizers or coloring agents, and medicaments such as antibacterial agents.

A preferred hydrogel for use in this invention is crosslinked polyvinylpyrrolidone (PVP). Best results have been achieved using PVP polymers having a viscosity average molecular weight of about 100,000-1,000,000 and preferably about 200,000-900,000. An especially preferred PVP polymer is PVP K-90, available from GAF Corporation, Wayne, New Jersey, having a viscosity average molecular weight of about 700,000. The viscosity average molecular weight was derived by the method described by W. Scholtan, *Makromol Chem.*, 7, 209 (1951) and J. Hengstenberg et al. *Makromol Chem.*, 7, 236 (1951). The hydrogel preferably comprises about 5 to 40, preferably about 10 to 30, weight % of the polymer complemented by about 60 to 95, preferably 70 to 90, weight % water. If the molecular weight of the PVP is too high, solution viscosities become too high to work with. If too low, effective crosslinking is difficult to achieve.

Referring now to Figure 1 illustrated there schematically is a cross-sectional view of a hydrogel dressing embodying the teachings of this invention. A layer of hydrogel 12 is coated onto the surface of a substrate 14 before the crosslinkable polymer of the hydrogel is crosslinked. The substrate 14 comprises a hydrogel facing surface 16 and an opposed surface 18. The substrate 14 is chosen such that the hydrogel facing surface presents anchoring projections 20 extending into the coating hydrogel layer 12. The opposing surface 18 is chosen so as to provide a hydrogel occlusive surface which will prevent the passage of any substantial quantity of hydrogel therethrough.

We have discovered that by producing the dressing described in general terms above and then crosslinking the hydrogel polymer in situ on the surface 16, the hydrogel layer, by virtue of the cooperation between the projections 16 and the in situ crosslinked polymer, is resistant to delamination from the substrate 14 to the extent satisfactory for producing a dressing for an adhesive bandage. At the same time, the hydrogel occlusive surface may be applied to an adhesive coated backing to form a bandage. Because of the occlusive nature of the opposed surface of the substrate, the dressing will adhere to pressure sensitive adhesive and resist delamination. It should be understood that, absent such an occlusive surface, the water present in high concentrations in the hydrogel would preclude such adherence and, heretofore, has represented a great drawback in attempts to produce adhesively attached bandages employing hydrogel dressings.

The substrate meeting the requirements set out above may take many alternative forms, as can be understood by one skilled in the art from the teachings set out herein. The criteria for the material making up the occlusive surface is that it must be occlusive to the extent that hydrogel is prevented from interfacing with adhesive, it must be adherent to the pressure sensitive adhesive of a coated bandage; it must be non-toxic and safe to use in conjunction with wounds; and it is preferably flexible and body conformable to the extent required

for bandages. Film-like materials such as polyolefin e.g., polyethylene or polypropylene, polyethylene vinyl acetate; or even other occlusive films such as waxes or cellophane may be employed. A material of choice is a block copolymer of polybutylene terephthalate and soft segment polyether glycols sold by the DuPont company as Hytrel. Primarily for processing reasons, the occlusive surface material should preferably be present in a thickness of from about 1 mil to about 5 mils and preferably from about 2 to about 4 mils in thickness.

It is envisioned that the hydrogel facing surface of the substrate 14 is provided with the anchoring projections 20 by incorporating, onto the occlusive surface, materials which will provide such suitable projections and generally, will be in the form of fibers. Such fibrous materials as rayon, polyester, wood pulp, cotton, cotton linter, wool or combinations thereof may all be used. While such fibers may be merely affixed to the material of the occlusive surface in a random fashion, it is preferred that the fibers are in the form of a paper, board or fabric, (woven or non-woven) and either coated with the material making up the occlusive surface or laminated thereto.

In whatever way the fibrous material is provided, it is preferred that the layer of fibers produce a thickness of about 5-15 mil and preferably from about 8 to about 12 mil. The fiber lengths may preferably vary from about 1/32 on an inch to about 3 inches and more preferably from 1/2 inch to about 2 inches. The fibers denier (in denier per filament) may vary preferably from about 0.5 to about 2.5 and more preferably about 1 to about 2. Fiber layers having a weight of about 1 to about 3 ounces per yard squares are preferred.

The dressing is, constructed in accordance with the teachings above, with the polymer of the hydrogel in the pre-crosslinked state. As taught herein, the hydrogel is then crosslinked, in situ, on the hydrogel facing surface of the substrate. Such crosslinking may be accomplished by means well-known in the art including for example, ionizing irradiation or chemical crosslinking.

Chemical crosslinking may be accomplished by virtue of the pendent hydroxy group present on the hydrogel polymers. Accordingly, difunctional or polyfunctional agents that condense with organic hydroxyl groups may be employed as crosslinking agents. These include various aldehydes such as formaldehyde acetaldehyde and glutaraldehyde; maleic acid and oxalic acid; dimethyl urea; polyacrolein; diisocyanate; divinyl sulfate and ceric redox systems.

Electron beam irradiation is the preferred type of ionizing irradiation. The suitable dose will, of course, depend upon the nature of the polymer(s), and can be determined by one skilled in the art. Tests suggest that the electron beam irradiation dose should preferably be at least about 2.0 Mrads and no more than about 4.0 Mrads. In a preferred embodiment, the electron beam irradiation is applied in two doses. Dose rates of about 2.0 and 2.5 Mrads, 2.5 and 2.5 Mrads, 3.0 and 2.5 Mrads and 3.5 and 2.5 Mrads have been shown to directly adhere the polymer to the substrate.

Irradiating the hydrogel dressing in two doses also provides a manufacturing benefit. After the first dose of ionizing irradiation, the hydrogel layer is partially cross-linked and has sufficient strength to be die cut into the desired shape and size. These die cut dressings may be processed into bandages using conventional techniques and then packaged in hermetically sealed containers, such as foil packs. The sealed containers are then subjected to the second dose of irradiation, which fully cross-links the hydrogel and sterilizes the product.

Referring to Figures 2 and 3, shown therein is such a die cut dressing 22 placed on a bandage backing 24 whose surface is coated with a pressure sensitive adhesive 26. The bandage backing may comprise a thin polymeric film and preferably is an embossed thermoplastic film in accordance with the teachings described, for example, in U.S. Patents 3,484,835; 4,298,647; and 4,376,147 incorporated herein by reference. The adhesive 26 may be any suitable medical grade pressure-sensitive adhesive as are well-known in the art. In the specific illustrated embodiment, the dressing 22 is in the form of an "island" pad but it will be clear to one skilled in the art that other bandage configurations may embody the teachings herein.

The advantages of the invention are illustrated by the following examples:

Comparative Example

To illustrate the difficulty encountered in employing hydrogel dressings, (even when reinforced) in pressure sensitive adhesive bandages, the following experiment was conducted. A bandage backing comprising a 2 mil thick copolyester ether elastomer (Hytrel 4778 from duPont) was coated on one side with a pressure sensitive adhesive consisting of an acrylic multipolymer emulsion adhesive (Gelva 2478 from Monsanto Corporation) at a coating weight of 1.2 oz/yd². The adhesive coated substrate was placed adhesive side up, in the cavity of a two plate metal mold measuring 14 inches by 14 inches. The bottom plate had a square cavity therein measuring 10 inches by 10 inches and was 60 mil deep; the top plate was flat. A hydrogel solution of the following composition was prepared:

Component	% by Weight
Polyvinylpyrrolidone (Plastone K-90 from GAF Corp.)	20.00
Methyl Paraben	0.26
Ethyl Paraben	0.03
Propyl Paraben	0.05
Butyl Paraben	0.01
2-Phenoxyethanol	0.50
Water	79.15

Sixty gms of the solution was spread over the adhesive coated side of the backing in the mold. A reinforcing layer comprising a fusible fiber fabric containing polyethylene and polypropylene fibers was placed over the hydrogel. A 7 mil thick release film of polyethylene was placed over the reinforcing layer.

The top plate of the mold was placed over the bottom plate and held for a few minutes to allow the reinforcing layer to become embedded into the hydrogel. The resulting structure was then removed from the mold and then irradiated using a two-pass electron beam irradiation process. The first pass delivered a dosage of 2.0 Mrads, while the second pass delivered 2.5 Mrads. After irradiation the adhesive between the hydrogel and the backing was examined. The hydrogel layer readily peeled from the backing.

Example 1

An adhesive coated backing identical to that of the foregoing example was placed in the same mold, adhesive side up. A substrate, conforming to the teachings of this invention was placed onto the adhesive coating fiber side up. The substrate is a non-woven fabric having co-extruded onto one side as the occlusive surface, a film of low density polyethylene at a lay down of 2 oz/yd². The fabric had the following composition:

	<u>Component</u>	<u>% by Weight</u>
5	Rayon Staple Fiber 1.5*dpf, 1-9/16" length (8171; BASF)	68.60
10	Polyester Staple Fiber 1.5 dpf, 1.5" length (Fortrel 310, Fiber Industries)	29.40
15	Acrylic Polymer Emulsion (Rhoplex HA-8; Rohm and Haas)	1.73
20	Silicone Antifoam Emulsion (Antifoam Y-30; Dow Corning)	0.01
25	Sodium Dioctyl Sulfosuccinate Surfactant (Deceresol OT Special, Cyanamid)	0.08
30	Ammonium Phosphate, Dibasic (Stauffer Chemical)	0.18

*Denier Per Filament

35 The fabric basis weight is 1.8 oz/yard square and was produced from the blend of 70% rayon and 30% polyester. The acrylic binder (HA-8) is applied by saturating the fabric in a padder.

40 Sixty grams of a gel composition identical to that of the foregoing example was spread over the fibrous side of the substrate. A 7 mil thick polyethylene release film was placed over the gel. The top plate of the mold was placed over the bottom plate for a few minutes to allow the embedding of the gel into the projecting fibers of the fabric surface of the substrate. The resulting structure was then removed from the mold and irradiated as described in the foregoing example.

45 After irradiation, the adhesion between the hydrogel and the substrate as well as the adhesion between the substrate and the pressure sensitive adhesive coating was examined. Very strong adhesion was observed and none of the layers could be readily peeled apart.

Example 2

50 A gel bandage was made in accordance with the procedure of Example 1 with the exception that a different substrate was employed. The substrate of this example comprised a web of individualized fibers prepared by feeding a picker lap comprising a blend of 80% by weight, bicomponent fibers and 20% by weight of rayon fibers to a standard carding engine. The bicomponent fibers were 3 denier and 1 1/2" staple and were supplied by BASF of Charlotte, N.C. The bicomponent fibers had a polyester core with a polyethylene sheath. The rayon fibers were 1.5 denier and 1.56 inch staple and were supplied by American Enka of Enka, N.C.

55 The formed web of individualized fibers weighing 0.98 oz/yard square was bonded by passing the web through a thru air bonder at 35 ft/min, at a drum temperature of 300°F using an 80 x 80 belt carrier. The bonded web was rolled up. The thru air bonder was supplied by Honeycomb Systems, Inc. of Biddeford, Maine.

The bonded rolled up web was combined in a face to face relationship with a coextruded ethylene vinyl acetate/ethylene film which was supplied by Edison Plastics of Edison, N.J. and identified as EVA 456. The

film was 1.5 mil in thickness. The EVA side of the coextruded film was placed in contact with the nonwoven fabric.

The film/bonded nonwoven were combined by processing them through a belt laminator at a speed of 4.5 yds/min under a belt tension of 40 psi and a roll pressure of 35 psi with a temperature setting of 115°C. The belt laminator was a model MTC 101-1000 as supplied by Stork of Charlotte, N.C.

When this substrate was employed in the gel dressing as per the prior example; and tested for delamination properties, it was found to resist such delamination.

10 Claims

1. A hydrogel dressing suitable for use in a pressure sensitive adhesive bandage comprising:
a layer of hydrogel, said hydrogel comprising a crosslinkable polymer and water;
said hydrogel layer being in face-to-face relationship with a substrate, said substrate having a hydrogel facing surface and an opposed surface;
said hydrogel facing surface comprising anchoring projections extending into said hydrogel layer;
said opposed surface being hydrogel occlusive; and said hydrogel being crosslinked, in situ, on said hydrogel facing surface and thereby anchored to said surface.
2. The dressing of claim 1 wherein the hydrogel facing surface comprises fibers.
3. The dressing of claim 2 wherein said fibers are selected from the group consisting of rayon, polyester, wood pulp, cotton, cotton linters, wool fibers or combinations thereof.
4. The dressing of claim 2 wherein the fibers are in the form selected from the group consisting of paper, board, or fabric.
5. The dressing of claim 4 wherein the fabric is a nonwoven fabric.
6. The dressing of claim 2 wherein the fibers have a length of from about 1/32 inch to about 3 inches.
7. The dressing of claim 2 wherein the fibers have a denier per filament of from about 0.5 to about 2.
8. The dressing of claim 2 wherein the fibers are present in a fibrous layer having a thickness of about 5 to about 15 mil.
9. The dressing of claim 8 wherein the fibrous layer has a thickness of about 8 to about 12 mil.
10. The dressing of claim 1 wherein the opposed surface of the substrate comprise a film of hydrogel occlusive polymer.

FIG.1

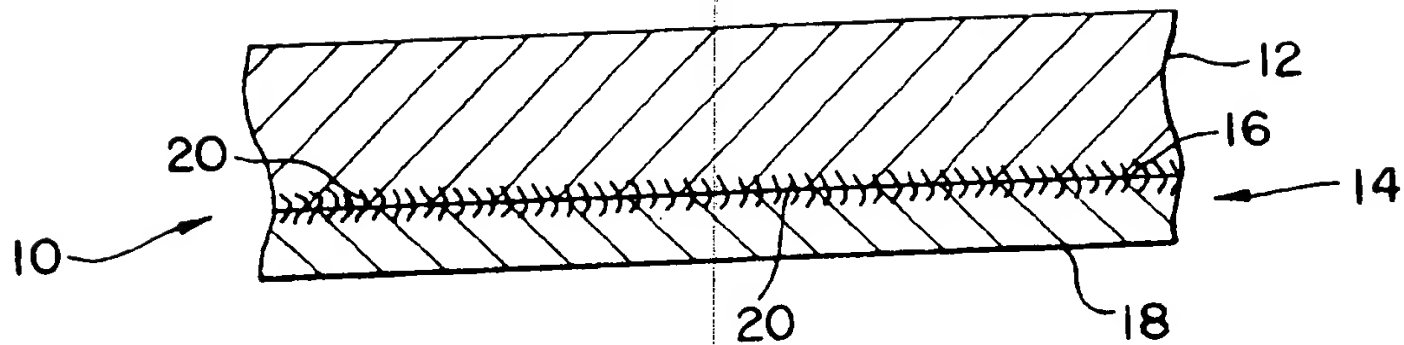


FIG.2

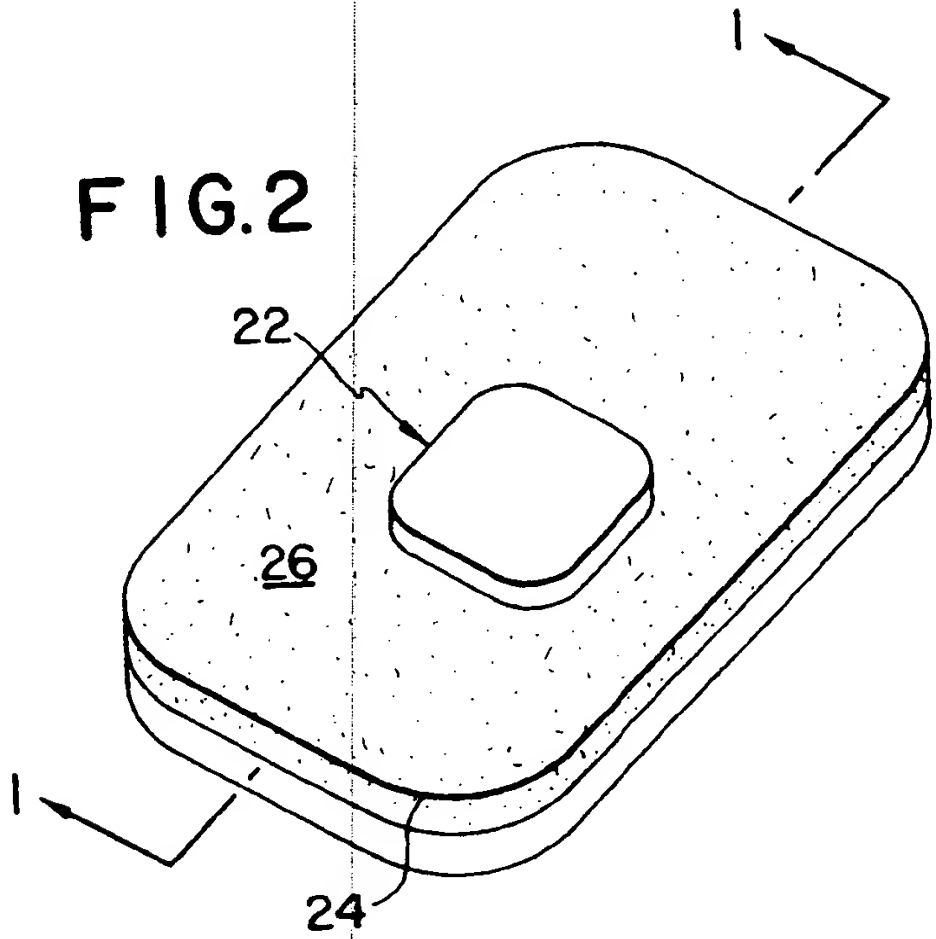
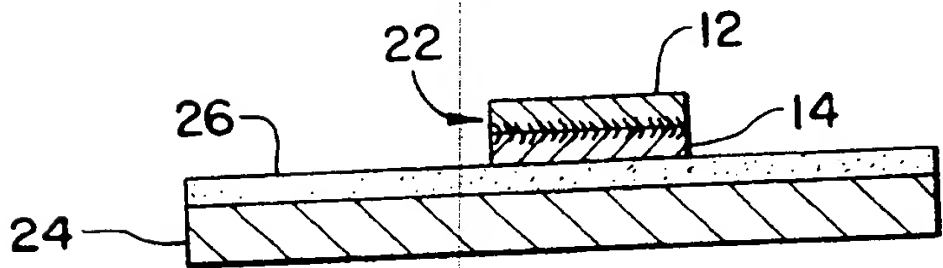


FIG.3





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 0720

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 5)
X	EP-A-0 450 671 (DUPHAR INTERNATIONAL RESEARCH B.V.) * the whole document *	1-10	A61L15/60 A61L15/58 A61F13/02
P,X	EP-A-0 536 875 (NDM ACQUISITION CORP.) * column 3, line 11 - line 25 * * column 4, line 38 - line 58; claims; figure 2 *	1-5	
Y	EP-A-0 455 324 (NDM ACQUISITION CORP.) * column 3, line 14 - line 52; claims *	1-10	
D,Y	EP-A-0 107 376 (JOHNSON & JOHNSON PRODUCTS INC.) * page 10, line 4 - line 25; claims *	1-10	
A	GB-A-987 779 (INDUSTRIAL SCIENCE LIMITED) * page 1, line 50 - line 86 *	1	
D,A	EP-A-0 304 536 (THE B.F. GOODRICH COMPANY) * claims *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. 5)
A	EP-A-0 190 814 (E.R. SQUIBB & SONS, INC.) * claims *	1	A61L
A	EP-A-0 424 165 (NDM ACQUISITION CORP.) * column 3, line 19 - line 52 * * column 6, line 31 - line 46; claims *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 March 1994	Examiner ESPINOSA, M
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